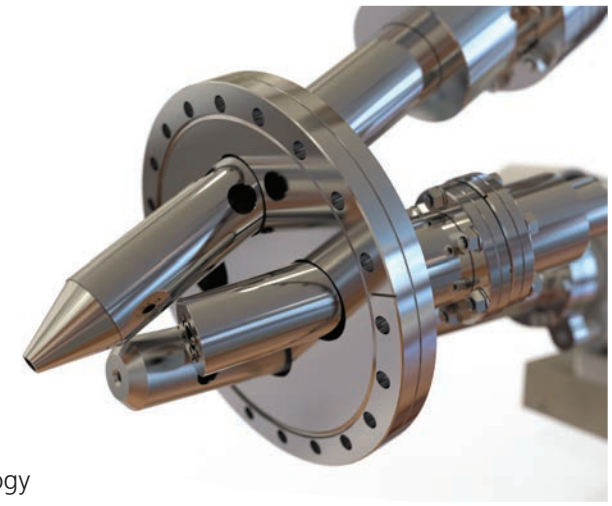
Why Does Nanotechnology Require Mass Spectrometry?

Benjamin Eaton, AZoNetwork



Modular SIMS

Nanotechnology refers to the research and development of matter at the molecular, macromolecular, or atomic scale. These microcosmic parameters exhibit different quantum mechanical properties from macroscale materials, supporting advancements towards previously theoretical phenomena such as quantum entanglement. The field of nanotechnology broadly encompasses a range of scientific and industrial fields, due to the definition of nanomaterials purely by its dimensions. To qualify as a nanomaterial, a substance must have a length of scale in at least a single dimensional plane of 1 – 100 nanometers (nm). However, this terminology includes sectors and academic areas as diverse as:

- Atomic engineering of products such as zero-emission vehicles;
- Microfabrication of complex yet miniature electrical circuits and mechanical equipment;
- Nanomedicine, where nanotechnology may be applied to improve diagnostics, drug delivery systems, and materials development for skin grafts and improved prosthetics.

These theoretical and emerging systems are based upon unique structures with novel characteristics that require robust testing and analysis to ensure they are suitable for eventual application in their field. Pharmaceutical or medicinal nanotechnology for example must be assessed to determine a material's potential toxicity in vivo.

Magnetic drugs targeting systems are an established branch of nanomedicine research, which focusses on conjugating drugs with metallic particles and manipulating the drug's targetability in vivo using magnetic devices. While this outstanding nanotechnology presents significant promise in treating an array of diseases and conditions, the potential blood toxicity of metals represents a large drawback that could negate the therapeutic effects of the administered conjugated drugs.

SIMS Workstation for thin film depth profiling

There are associated concerns with each branch of nanotechnology, as tends to be the case with any new system. It is crucial therefore that nanomaterials are assessed holistically and specifically to application purposes to ensure their characteristics are suitable for application.

Mass Spectrometers for Nanotechnology

Mass spectrometers for nanotechnology applications are tailored to perform:

- Depth profiling of thin film structures;
- Plasma characterisation for device microfabrication;
- Desorption analysis in ultra-high vacuum (UHV) chambers.

These processes are enabled and optimised by a broad product range from Hiden Analytical, including the SIMS workstation. This UHV quadrupole mass spectrometer can perform depth profiling of thin film structures with nanometer dimensions and characterising the surface composition of various nanomaterials. It has been used to assess the efficiency of semiconductor materials for organic photovoltaics (OPVs) to improve the functionality of solar cells and other thin film structures.

Hiden Analytical are experts in the design and manufacture of mass spectrometry equipment for multiple sectors and disciplines. Over the last 35 years we have established a reputation for supplying high quality quadrupole mass spectrometers for various studies and research purposes, with mass spectrometry systems and equipment capable of performing a range of techniques suitable for nanotechnology sectors. Alongside the SIMS workstation, our product catalogue includes:

- TPD Workstation for temperature programmed desorption at UHV from ambient to 1000°C
- XBS for deposition rate control in molecular beam epitaxial deposition to 0.01Angstrom per second
- HPR-60 MBMS for analysis of reaction kinetics including analysis of short lived radical species, positive and negative ions from plasma and combustion processes.
- FIB-SIMS for analysis of surfaces with the spatial resolution of focused ion beam electron microscopy.

If you would like any more information about Hiden Analytical's mass spectrometers for nanotechnology applications, please do not hesitate to contact us.